

WD-A188 050

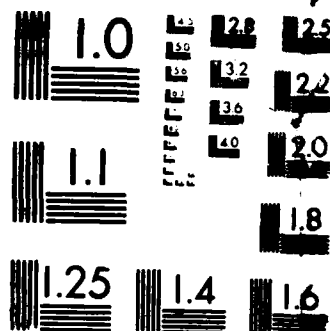
A CODE DEVELOPMENT SYSTEM FOR COMPUTATIONAL FLUID
DYNAMICS(U) TEXAS UNIV AT AUSTIN COLL OF ENGINEERING
D A ANDERSON 30 SEP 87 AFOSR-TR-87-1708 AFOSR-86-0293
F/G 20/4

1/1

UNCLASSIFIED

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

IT DOCUMENTATION PAGE

1a. RE		1b. RESTRICTIVE MARKINGS	
2a. SE		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE		5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR. 87-1708	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		7a. NAME OF MONITORING ORGANIZATION AFOSR/NA	
6a. NAME OF PERFORMING ORGANIZATION University of Texas at Arlington	6b. OFFICE SYMBOL (If applicable)	7b. ADDRESS (City, State, and ZIP Code) AFOSR/NA Bldg. 410 Bolling AFB, DC 20332-6448	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION AFOSR	8b. OFFICE SYMBOL (If applicable) NA	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-86-0293	
8c. ADDRESS (City, State, and ZIP Code) AFOSR/NA Bldg. 410 Bolling AFB, DC 20332-6448		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO. 61102	PROJECT NO. 2917
		TASK NO. A1	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) A Code Development System for Computational Fluid Dynamics			
12. PERSONAL AUTHOR(S) Anderson, Dale A.			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM 10/1/86 TO 9/30/87	14. DATE OF REPORT (Year, Month, Day) 87-9-30	15. PAGE COUNT 10
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
		URIP	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
Funds provided through this grant have been used to purchase a SUN 3/160C workstation as the major element in the workstation network in the computational fluid dynamics activity at the University of Texas at Arlington. The computing facilities available for this activity are described and major research projects using this DoD funded workstation are outlined. These programs include a range of topics from fundamental work in grid generation to applications in flowfield calculation for specific configurations.			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. James D. Wilson		22b. TELEPHONE (Include Area Code) 22c. OFFICE SYMBOL 202-767-4935 AFOSR/NA	

AFOSR-TR. 87-1708

Final Report

A Code Development System for
Computational Fluid Dynamics

AFOSR - 86 - 0293

Principal Investigator
Dale A. Anderson

September 30, 1987

COLLEGE OF ENGINEERING



**The University
of Texas at Arlington**
Arlington, Texas:

87 11 17 006

Final Report

A Code Development System for
Computational Fluid Dynamics

AFOSR - 86 - 0293

Principal Investigator
Dale A. Anderson

September 30, 1987



Accession For	
NTIS CRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Prepared for

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
Bolling AFB, DC 20332-6448

TABLE OF CONTENTS

1. Summary
2. Computing facilities for CFD at the
University of Texas at Arlington
3. Equipment Purchased under grant AFOSR-86-0293
4. Major research projects using Workstation Network

SUMMARY

The computational fluid dynamics activity at The University of Texas at Arlington is designed to provide excellent educational programs and research opportunities for students and faculty. The computational facilities available are a major element in providing the environment necessary for the success of such a program.

An early decision was made to establish a network of engineering workstations to form the basis for a state of the art code development system. As part of this network, DoD through the Air Force Office of Scientific Research provided funds through grant AFOSR-86-0293 to establish the largest and most powerful workstation in the network. In this report, a description of available computing facilities is provided, the equipment purchased under this grant is listed and major research projects currently funded using the new workstation system are briefly outlined.

Description of Computing Facilities

The computational facilities of the Computational Fluid Dynamics Group of the Department of Aerospace Engineering at the University of Texas at Arlington are based on a Sun Microsystems workstation network. The Sun 3 workstations are built around the Motorola 68020 32-bit microprocessor, and run the 4.2BSD Unix operating system. A desktop windowing system runs on top of the Unix operating system resulting in a highly productive development and graphics environment. At present, the system consists of two color Sun 3/160 and four monochrome Sun 3/50 workstations networked with the NFS filing system over a local ethernet. One of the 3/160's has 12 MBytes of RAM and 70 MBytes of disk storage, while the other 3/160 has 20 MBytes of RAM and 380 MBytes of disk storage and acts as the file server for the network. The 3/50's have 4 MBytes of RAM and are diskless clients of the file server 3/160. In addition, the system includes a Silicon Graphics Iris 1400 color graphics workstation (also running Unix). The Iris is capable of displaying and transforming (rotating, translating and scaling) three-dimensional, color images in real time, and therefore is very useful for analyzing the results of three-dimensional digital simulations. It is connected to the Sun network through a serial line. Peripheral equipment includes: 1) an Apple LaserWriter printer for hard-copy output, 2) a dot matrix printer for code listings, 3) a 1200 baud and a 2400 baud modem, and 4) three terminals. The Sun network, the Iris and the peripheral equipment are all connected through a local smart port contender. The port contender is also connected to the UTA micom system which allows us to connect directly (through a 9600 baud serial line and DECNET) to the University of Texas System Center for High Performance Computing (UTCHPC). The UTCHPC consists of a Cray XMP-24 two processor vector supercomputer with a top speed on the order of a hundred MFLOPS. The combination of the local workstation network and access to a supercomputer gives an optimal computing environment for digital simulation research.

Equipment Purchased Under Grant

AFOSR 86-0293

The first and largest color Sun 3/160C in the CFD workstation network was purchased with funds made available through this grant. This workstation has been used as a server and general computational node, as well as a workstation, since installation in December, 1986. Equipment purchased under this grant was outlined in the original proposal and is listed below for completeness.

<u>Quantity</u>	<u>Description</u>	<u>Price</u>
1	3/160C-8 Sun-3/160 C Workstation	\$ 27,230.00
1	3/160C-150 FPA (Floating Point Accelerator) board	3,430.00
1	3/160-160 Dual-wide to triple-wide VME adapter board	280.00
1	3/160C-201 Graphics Processor	4,130.00
1	3/160C-202 Graphics Buffer	2,800.00
1	3/160-620++ 380 MByte (formatted) disk subsystem	13,930.00
1	3/160-670++ 1600bpi 1/2 inch tape drive subsystem	6,650.00
1	3/160-950 40 inch half height rack	1,575.00
1	Sun/LW-3 Sun Laser Writer, 240 VAC	6,587.50
1	Sun/LW-OPT-02 Software distribution and Manuals (1/2" reel) U.S. and International	N/C
1	Sun/LW-OP-21 Toner Cartridge-Four Pak	500.00
1	ETHKIT-TAP Ethernet transceiver with 15 meter (49 ft.) branch cable and 'vampire tap' cable connector	500.00
1	SYSL-1 Single User Unix License	N/C
1	SYS3-02 Software Distribution and Manuals	315.00
		<hr/>
		\$ 67,927.50
Freight		1,565.50
		<hr/>
		\$ 69,493.00

Research Projects
using the
SUN Workstation Network

Current DoD Funded Program

Title: Development of Adaptive Grid Schemes based
on Poisson Grid Generators

Funding Agency: AFOSR

Grant Number: AFOSR - 85 - 0195

Principal Investigator: Dale A. Anderson

Algorithms for providing adaptive mesh capability based on Poisson grid generators such as Thompson's method are presently under development. These adaptive schemes provide the locations of the nodal points as part of the solution of any general problem where numerical methods are used to compute the solution to a system of partial differential equations. The graphics capability provided with the SUN Workstations is a valuable tool in this type of research. Focus of the program at this time is in perfecting a two-dimensional, orthogonal, adaptive technique and in formulating a finite-volume solution to the Poisson equation in order to apply adaptive concepts on arbitrarily shaped elements.

Current NASA Funded Program

Title: Plume Interference Studies

Funding Agency: NASA

Grant Number: NAG9-194

Principal Investigator: Dale A. Anderson

Observations of flight vehicle loads during Space Shuttle launch have led to apparently anomalous behavior over a limited portion of the flight trajectory. Specifically, data indicates sufficiently high aerodynamic loading on the orbiter in launch configuration to necessitate a pitch altitude adjustment to maintain structural integrity at transonic speeds. This experience suggests that a potential cause is the interference from the orbiter-booster tank configuration when the underexpanded exhaust plume encounters multiple bodies. The goal of the present study is to provide a viscous simulation of flow from a single nozzle in proximity to another body and to observe the change in flight environment. Although a number of wind tunnel experiments have simulated the plume problem, results of these confined tests do not predict the physical effects observed in flight. If plume interference does contribute to the flight loading problem, it is hoped that a numerical simulation will reveal the details and causes of this difficulty.

Currently Funded Program

Title: A Zonal Method for Extending the
Applicability of the PNS Equations

Funding Agency: Industrial Grant

Principal Investigator: David Thompson

The Parabolized Navier-Stokes approximation has been used to good advantage in high supersonic and hypersonic flows. One of the main difficulties in applying the PNS equations is that the velocity in the space marching direction must be positive. Consequently, no regions of streamwise separated flow can be tolerated. This program is designed to address the issue of streamwise separation by solving the Navier-Stokes equations in those regions where the PNS approximation fails. Part of the research under this project has lead to an interesting study of techniques for solving the full time-dependent Navier-Stokes equations using a space-marching approach.

Funded Program

Title: Numerical Simulation of Helicopter
Rotor Flowfields

Funding Agency: Industrial Grant

Principal Investigator: Dale A. Anderson

One of the true challenges to the numerical fluid dynamicist is the calculation of the flow through of a helicopter rotor in forward motion. This particular problem has fundamentally different properties than the corresponding fixed wing problem and this must be accounted for in correctly formulating the problem. The current program has been used to calculate the flow through of a rotor in hover and is written in sufficiently general terms that the forward flight case can also easily be treated. The code is written to solve the Euler equations with the goal of computing solutions using the Navier-Stokes equations.

END

FEB.

1988

DTic